

# Government Spending and Private Consumption: Crowding In or Crowding Out?

*Evidence from Norway*

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II



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# Content

1. Introduction
2. Theoretical Background and Literature Review
  1. Empirical Literature Review
  2. Neoclassical Framework
  3. Keynesian Framework
3. Vector Autoregression
  1. Methodology
  2. Data Description
  3. Estimation and Results
4. Model and Application
  1. Modified RBC model by Bouakez and Rebei
  2. Estimation Method
  3. Estimation Analysis and Results: ARDL Model
    - i. General Government Level
    - ii. Central Government And Local Government Level
  4. Limitations
5. Conclusion



# 1 Introduction

Due to recent crisis of 2008 fiscal policy regained interest of policymakers and researchers. Because of housing bubble explosion, which started in 2007, monetary policy became ineffective due to liquidity trap, when the interest rate hit the lower possible bound. When the economy reaches the liquidity trap or investment trap conditions, expansionary fiscal policy viewed as recovery tool of policymakers. That made the world of economists to shift the interest in favor of fiscal policy analysis, in particular, the effectiveness of economy stimulation through increase in government expenditure. EERP is an example of the expansionary fiscal policy strategy implemented by Euro Area at the end of 2008. European Economic Recovery Plan aimed to provide short-term impulse to total demand in term of increase in GDP by 4% compared to no stimulation case. However, the effectiveness of EERP prompt debate within the economists, since the economy did not show strong and sufficient improvements.

As other European countries, in response to Great Recession, Norway in the second half of 2008 increased its total government expenditures by 6.4% and increased the ratio of total government expenditures to GDP by 5.9% in 2009. The response of Norwegian economy in terms of GDP growth was slow and inconsistent, falling in 2009 and returning to growth tendency beginning of 2012. Therefore, it is hard to see in what way the fiscal policy stimulation affected the economy. Moreover, since household's consumption is the main component of the GDP, being 40.5% at the end of 2013, followed by fairly equal share of government spending and investment, 21.6% and 21.7% respectively. Having in mind, importance of household's consumption for Norwegian economy, it is crucial to know how the fiscal policy can stimulate private consumption.

Notwithstanding the fact of increased interest of researchers in the influence of government spending on private consumption and its effectiveness as tool to economy stabilization, both theory and empirical evidence does not provide obvious answers. Actually, various studies showed controversial results depending on the methods used for estimation methodology. Most of the papers employ: descriptive methodology with various estimation ways (Ramey and Shapiro, 1998; Burnside, Eichenbaum and Fisher, 2003; Mountford and Uhlig, 2004; Coenen and Straub, 2009; Bouakez and Rebei, 2005; Gali, Valles and Lopez-Salido, 2007) and Vector Autoregression (VAR) methodology (Blanchard and Perotti, 2002; Perotti, 2002;

Fatas and Mihov, 2001; Bouakez and Rebei, 2005; Gali, Valles and Lopez-Salido, 2007) to estimate the relationship between government spending and private consumption. Most of the empirical studies, under VAR and descriptive methodology, estimated positive effect of government spending expansion on private consumption.

As well as empirical studies, theoretical frameworks, employing various assumptions, predict opposite results. The relationship between government spending and private consumption can be explained in terms of Keynesian, New Keynesian and neoclassical theories that generate completely opposite outcomes. Under the neoclassical theory and New Keynesian theories, government spending expansion will crowd out private consumption through negative wealth effect dominance. However, Keynesian theory predicts increase in private consumption in response to government spending shock, which is called crowding in phenomena.

In purpose to explain the crowding in phenomena, which is consistent with empirical findings, economists managed to derive positive response of private consumption to government spending shock by modifying standard RBC model and standard New Keynesian model. Bouakez and Rebei (2005) modified standard RBC model with assumptions of effective consumption, which allows government spending to enter households utility function, and habit formation to estimate crowding in effect. Gali, Lopez-Salido and Valles (2007) developed the idea of Mankiw (2000) of rule of thumb consumers and extended standard New-Keynesian model with presence of non-Ricardian households in addition with price stickiness and deficit financing given imperfectly competitive labor market. Gali et al. (2007) successfully managed to show positive relationship between government sending shock and private consumption.

This paper applies the modified RBC model to test the presence of crowding in effect in case of Norway. The analysis of effect of government spending on private consumption is divided on three levels: general government spending, central government spending and local government spending. Given subdivision will allow to see if expansionary fiscal policy is effective tool to stimulate household`s consumption on scale of whole country and local scale. As empirical estimation methodology, the paper employs ARDL model, which gained popularity recently and proved to be effective tool to estimate long run relationship.

The rest of the paper organized as follows: Section 2 provides theoretical background to analyze the relationship of government spending and private consumption. Section 3



describes VAR methodology and it's estimation. Section 4 introduces Bouzkez and Rebei modified model and estimates it using ARDL model. Section 5 concludes.

## **2 Theoretical Background and Empirical Literature Review**

The effect of government spending on private consumption can be explained under several theoretical frameworks: neoclassical theory or Real Business Cycle model, Keynesian or IS-LM model, and New Keynesian model; and each predicts opposite outcome. It is worth saying that each model shows positive effect of government spending on output and having consumption as significant part of output it is crucial to have clear understanding of consumption–government spending relationship.

### **2.1 Empirical Literature Review**

Before turning to theoretical explanation of the effects of government spending on private consumption, review of empirical evidence would be useful. Empirical findings on the response of private consumption on increase in government spending do not speak with one voice and, depending on the methodology used, provides different results. While most of reviewed studies find positive response of private consumption to a government spending increase, the magnitude of the response is different. It vary from large, positive and significant (Blanchard and Perotti, 2002; Perotti, 2002; Fatas and Mihov, 2001; Linnemann, 2006; Bouakez and Rebei, 2005; Gali, Valles and Lopez-Salido, 2007) to small and rather insignificant (Mountford and Uhlig, 2004; Coenen and Straub, 2009). In contrast, the analyses based on Ramey-Shapiro episode (Ramey and Shapiro, 1998; Burnside, Eichenbaum and Fisher, 2003), which is segregation periods of military spending shocks, show negative response of private consumption on government spending expansion.

Principally the empirical analysis split up into two categories: descriptive methodology with various estimation ways and Vector Autoregression (VAR) methodology. Majority of studies based on VAR estimates the same positive response of private consumption to increase in government spending (Blanchard and Perotti, 2002; Perotti, 2002; Fatas and Mihov, 2001; Bouakez and Rebei, 2005; Gali, Valles and Lopez-Salido, 2007). While descriptive methodology depends on estimation procedures and data set, thus shows diverse results, both possibility of crowding in and crowding out (Ramey and Shapiro, 1998; Burnside,

Eichenbaum and Fisher, 2003; Mountford and Uhlig, 2004; Coenen and Straub, 2009; Bouakez and Rebei, 2005; Gali, Valles and Lopez-Salido, 2007).

As it comes to the effect of expansionary fiscal policy in terms of increase in government spending on outcome, the reviewed studies show the positive impact, the size of which depends on country. Further on, the respond of investment commonly in a negative manner (Bouakez and Rebei, 2005; Blanchard and Perotti, 2002; Coenen and Straub, 2009; Mountford and Uhlig, 2004), while other studies showed positive comovement between government spending and investments (Gali, Valles and Lopez-Salido, 2007; Burnside, Eichenbaum and Fisher, 2003; Fatas and Mihov, 2001). According to Gali et al. (2007), Fatas and Mihov (2001), and Bouakez and Rebei (2005) wage tends to grow with increase in government spending. As for hours worked, Fatas and Mihov (2001), and Bouakez and Rebei (2005) found negative effect, however Gali et al. pointed increase in hours worked starting at second quarter after shock.

Overall, empirical evidence on the effects of government spending expansion is quiet various. Yet, the presence of crowding in effect is obvious and supported by the data.

## 2.2 Neoclassical Framework

Standard Real Business Cycle (RBC) model, under the framework of neoclassical theory, predicts reduction in private consumption in the response to an increase in government spending, which is known as crowding out effect. Baxter and King (1993) employed standard RBC model, assuming infinitely-lived Ricardian households, whose consumption decisions depends on intertemporal budget constraint, to analyze the effects of fiscal policy and showed that rise in government spending financed by lump-sum taxes will decrease households' permanent income. Such an effect called negative wealth effect. Reacting to the increase in taxes, households tend to work more so increase labor supply, which is called substitution effect. Under the standard RBC model, substitution effect is not strong enough to cover negative wealth effect. As the result, private consumption decreases.

Since empirical results mismatch with the outcomes of neoclassical theory, the use of standard RBC model in explaining positive response of private consumption to increase in government spending considered being besides the purpose. However, under specific modifications it is possible to generate crowding in effect using RBC model in terms of neoclassical framework.

To explain nature of government spending crowding in private consumption, Linnemann (2006) adapted standard RBC model with nonadditively separable utility function specification. The necessary condition for this modification is intertemporal elasticity of substitution between consumption and leisure smaller than one (King, Plosser, and Rebelo, 1988). Considering these specifications, increase in government spending reduces the private resources available to households, as the result, negative wealth effect arises, which reduces demand for leisure, meaning increase in employment. Under the assumption of nonadditively separable utility, leisure and consumption should be substitutes, while employment and consumption should be complements. Thus, expanded employment and working hours cause the marginal utility of consumption to increase. Depending how strong the degree of complementarity among consumption and employment, the response of private consumption, as well as output and working hours, to the government spending expansion will be positive.

Bouakez and Rebei (2005) modified standard RBC model with assumptions of effective consumption, which allows government spending to enter households utility function, and habit formation that assumes dependence of utility function on current level of effective

consumption. Using data for the USA the positive effect of government spending on private consumption obtained with the necessary condition of Edgeworth complementarity among government spending and private consumption, under which increase in government spending increases the marginal utility of private consumption, providing additional stimulus for households to work more, thus offsetting negative wealth effect.

Assumption of complementarity considered as one of essential tools to generate crowding in effect. Ganelli and Tervala (2009) employed the degree of complementarity as main tool of generating crowding in effect. Yet, the empirical studies of complementarity and substitutability between government spending and private consumption do not speak with one voice. Nieh and Ho (2006) checked 23 OECD countries for intertemporal and intratemporal substitution between government spending and private consumption and found Edgeworth-Pareto complementarity between them. Guo-ping, Dong, Li-Zhen (2007) conducted panel cointegration analysis among different regions in China and estimated intertemporal and intratemporal substitution between government spending and private consumption. As the result, they found prevailing degree of complementarity in 20 out of 29 regions and very weak degree of substitution in 4 regions of China. On the other hand, Katsaitis (1987) estimated weak degree of substitution between government spending and private consumption in Canada. Strong degree of substitutability was estimated by Ni (1995). In addition, Chiu (2001) found strong presence of intratemporal substitution of public-private consumption in Taiwan. Following Chiu, Ho (2004) conducted estimation of intratemporal elasticity of substitution between government spending and private consumption and showed presence of weak crowding out effect in Japan. However, Karras (1994) conducted cross-country analysis and showed government spending and private consumption are rather complements than substitutes.

## 2.3 Keynesian Framework

Traditional Keynesian theory or IS-LM model predicts crowding in effect that is an increase in private consumption in response to an increase in government spending. Difference between outcomes of neoclassical and Keynesian frameworks happens due to behavior of households. IS-LM considers non-Ricardian households, whose consumption depends on their disposable income allowing crowding in effect.

Crowding in effect considered as a typical Keynesian feature, however, standard New Keynesian model predicts opposite result. According to Khun, Muysken, van Veen (2010) standard New Keynesian model with sticky prices considers rational forward-looking households who seek to maximize their intertemporal utility constrained not to disposable income as in traditional Keynesian theory, but to lifetime income.

Notwithstanding, Campbell and Mankiw (1989) showed that empirically consumption seems to be contingent on disposable income in a greater extent than assumed by standard New Keynesian theory. Thereafter, Mankiw (2000) proposed a modification of the model that would allow diversity in the demand side, which includes two types of households: fully optimizing and forward-looking household, savers and simple rule of thumb households, spenders. Mankiw used data from the United States and justified the diversification of households. First, by studying consumption patterns of households, author estimated that consumption smoothing over lifetime is far from perfect and consumption relies on disposable income much greater than it is theoretically allowed. Second, Mankiw argues that large portion of households act in a rule of thumb manner and consume disposable income, so do not save and do not smooth consumption over periods.

Further, Gali, Lopez-Salido and Valles (2004) developed the idea of Mankiw (2000) and extended standard New-Keynesian model with presence of non-Ricardian households in addition with price stickiness and deficit financing given imperfectly competitive labor market, which allows economy-wide union to set the wage. Assuming these features, Gali et al. demonstrated the model, where cooperation of two types of consumers with firms that rarely adjust prices and government that issues debt to fund part of its spending, is capable to generate positive effect of government spending on private consumption. Introduction of sticky prices assumption makes labor demand reaction stronger than the labor supply reaction and allows for real wages to rise even under the decreasing marginal product of labor. Under

assumption of imperfect labor competition increase in output results in a rise of profits and income. Given these features, the channel of crowding in phenomena is following: Having sticky prices, an increase in public spending leads to higher aggregate demand, as a response, firms react with expansion of demand for labor, which leads to an increase in real wage, under the non-competitive labor market. Increase in real wage translates into higher disposable income of non-Ricardian household, thus increasing their consumption. The sufficient share of non-Ricardian households offsets the negative wealth effect and increases the aggregate private consumption.

The importance of rule of thumb consumers was investigated by Coenen and Straub (2005) using data for Euro Area. Following Gali et al. Coenen and Straub (2005) supplemented the standard New Keynesian model with price stickiness and monopolistic labor market. In addition, authors introduced wage stickiness and precise fiscal policy framework. Results show that in Euro area share of non-Ricardian households is relatively small and possibility for crowding in effect is small due to strong and substantial negative wealth effect. Still, Coenen and Straub (2005) state that the role of presence of non-Ricardian households is important in the analysis of expansionary fiscal policy effects since the willingness of Ricardian households to smooth consumption over time in the absence of rule of thumb consumers tend to be lower.

Gali et al. (2007) state that the assumption of rule of thumb consumers is not enough to generate crowding in effect and additional assumptions of sticky price and monopolistic labor market are necessary, thus their model highly depends on the response of real wage. While empirically, Fatas and Mihov (2001), Coenen and Straub (2005) show that the response of real wage to a government spending shock is not sufficiently strong.

Despite the theoretical predictions, Linnemann and Schabert (2003) modified standard New Keynesian model with sticky prices and generated positive effect of government spending on private consumption. They proposed to modify household utility function with entering government spending. In the combination with sufficiently low elasticity of substitution, demand side modification can recoup negative wealth effect. However, the modified model and results depends on cooperative monetary policy and in case of it being aggressive, private consumption will decrease, as negative wealth effect will prevail.

Given the variety of models under both theoretical frameworks, for the purpose of analysis of government spending effect on private consumption with data for Norway, the paper will employ RBC model, modified by Bouzkez and Rebei (2005). Before analyzing the relationship between government spending and private consumption, the next section will conduct empirical estimation using VAR model to see the presence of crowding in effect in Norway.



# 3 Vector Autoregression Model

## 3.1 VAR Methodology

Before proceeding to neoclassical model description and empirical estimation, the effects of government spending shock is investigated using VAR model, which does not require model description and explanation of mechanisms used. VAR employs minimal restrictions and totally data driven. The advantage to given methodology is that it is appropriate to identify the effects of government spending shock and separate the response of regression variables over and their transmission over time.

The paper employs the simple two-lag VAR model of the following form:

$$\mathbb{Y}_t = \alpha_0 + \alpha(L, y)\mathbb{Y}_{t-1} + \beta x_t + \mathbb{U}_t.$$

Where  $\mathbb{Y}_t = [LNGS_{t,i}, LNPC_{t,i}, LNGDP_{t,i}, LNWG_{t,i}, LNHW_{t,i}, LNI_{t,i}]$ , or vector with endogenous variables.  $x_t$  is vector of exogenous variables and  $\mathbb{U}_t$  is a vector of reduced form residuals. Variables government spending, private consumption, GDP, hours worked, wage, and investment are endogenous and constant term, c, is exogenous variable. Following Blanchard and Perroti (2002) and Gali et al. (2007), to identify government spending shock, the variable of government spending will be ordered first. The vector representation takes following form:

$$\begin{pmatrix} LNGS_t \\ LNPC_t \\ LNGDP_t \\ LNWG_t \\ LNHW_t \\ LNI_t \end{pmatrix} = \begin{pmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} & \dots & \alpha_{16} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} & \dots & \alpha_{26} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} & \dots & \alpha_{36} \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & \dots & \alpha_{46} \\ \alpha_{51} & \alpha_{52} & \alpha_{53} & \dots & \alpha_{56} \\ \alpha_{61} & \alpha_{62} & \alpha_{63} & \dots & \alpha_{66} \end{pmatrix} \begin{pmatrix} LNGS_{t-1,i} \\ LNPC_{t-1,i} \\ LNGDP_{t-1,i} \\ LNWG_{t-1,i} \\ LNHW_{t-1,i} \\ LNI_{t-1,i} \end{pmatrix} + \begin{pmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \dots & \beta_{16} \\ \beta_{21} & \beta_{22} & \beta_{23} & \dots & \beta_{26} \\ \beta_{31} & \beta_{32} & \beta_{33} & \dots & \beta_{36} \\ \beta_{41} & \beta_{42} & \beta_{43} & \dots & \beta_{46} \\ \beta_{51} & \beta_{52} & \beta_{53} & \dots & \beta_{56} \\ \beta_{61} & \beta_{62} & \beta_{63} & \dots & \beta_{66} \end{pmatrix} \begin{pmatrix} LNGS_{t-2,i} \\ LNPC_{t-2,i} \\ LNGDP_{t-2,i} \\ LNWG_{t-2,i} \\ LNHW_{t-2,i} \\ LNI_{t-2,i} \end{pmatrix} + \begin{pmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \\ c_6 \end{pmatrix} + \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \end{pmatrix}.$$

## 3.2 Data Description

The aim of this paper is to analyze the response of private consumption on increase in government spending shocks in three different levels: general government, central government and local government. This will allow to decide whether expansionary fiscal policy in terms of increase in government spending is effective in stimulation of household's consumption in the scale of state or smaller subdivisions. The whole set of data is taken from Statistics Norway.

This paper exploits quarterly data from 1995K1 to 2014K4 on the following variables:

LNGS – log value of total general government expenditure,

LANGSC – log value of total central government expenditure,

LNGSL – log value of total local government expenditure,

LNPC – log value of total household expenditure,

LANGDP – log value of total gross domestic product,

LNWG – log value of wage compensation in non-farm business sector,

LNHW – log value of aggregate hours registered in non-farm business sector,

INI – log value of non-residential investment.

### 3.3 VAR: Estimation and Results

Before running the VAR model and estimating results, the check of data on stationarity have to be provided. To check for unit root, the paper employs Augmented Dickey Filter (ADF) and Dicky-Fuller Generalized Least Square (DF-GLS) tests. Both tests showed stationarity of the data. The results will be presented later in analysis of ARDL model.

First of all, the test of model stability and serial correlation have to be carried out. To check presence of serial correlation among variables the LM test is performed. The results proved the absence of serial correlation among government spending, private consumption, GDP, hours worked, wage, and investment given two lag VAR.

*Table 1 Serial Correlation Test: VAR*

VAR Residual Serial Correlation

LM Tests

Null Hypothesis: no serial  
correlation at lag order h

Date: 10/14/15 Time: 09:47

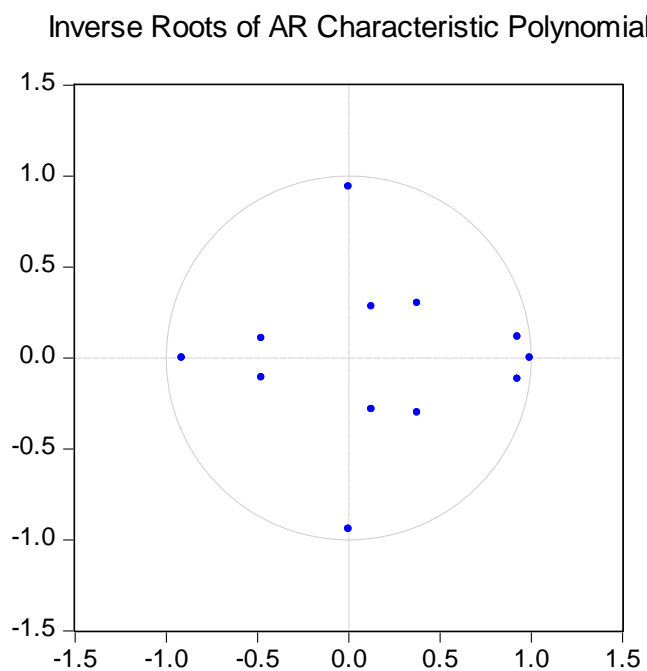
Sample: 1995Q1 2014Q4

Included observations: 78

Lags	LM-Stat	Prob
1	61.89188	0.0046
2	57.73845	0.0122
3	37.51627	0.3995
4	43.34108	0.1868
5	63.13467	0.0034
6	44.49723	0.1564
7	24.38466	0.9294
8	44.11286	0.1661
9	30.19208	0.7407
10	43.02518	0.1957
11	28.42917	0.8116
12	24.00261	0.9370

Probs from chi-square with 36 df.

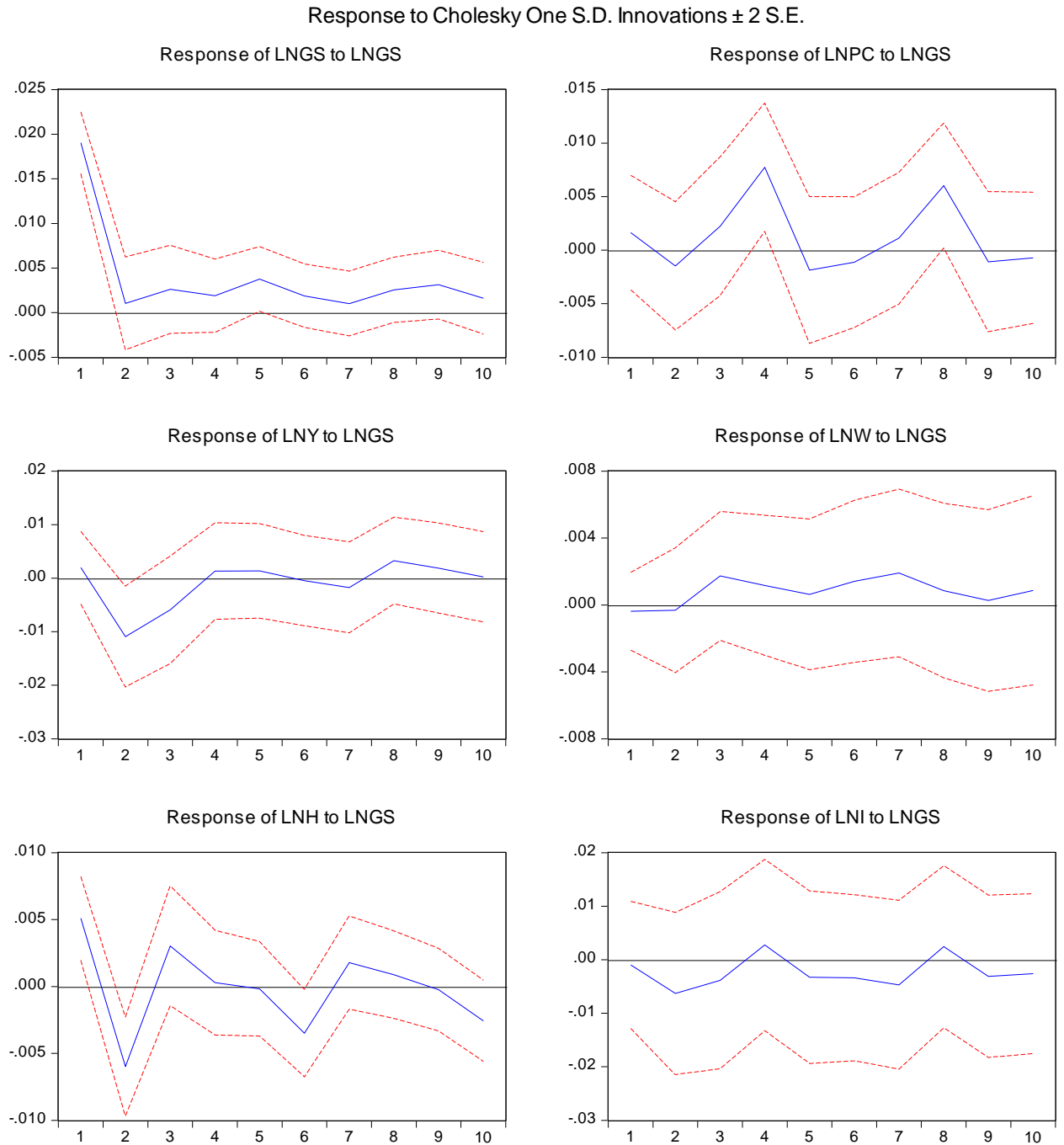
To check stability of the VAR model, the inverse roots have to be revised by AR Roots Graph, which illustrates that estimated VAR model is stable.



*Figure 1 Dynamic Stability Test: VAR*

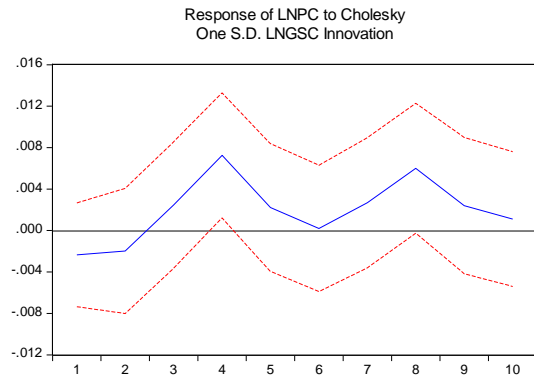
Figure 2 displays the estimated impulse responses on general government spending shock. The response of general government spending is significant and persistent starting from second quarter after shock. Private consumption is shown to decrease at the beginning, but starting from second quarter shown to have drastic ups and downs, so the response of private consumption is not smooth over the time. However, general government spending crowds in private consumption in the long-run perspective, which is consistent with Keynesian framework and modified neoclassical and New-Keynesian models. The effect of central government spending shock on private consumption is very similar to the estimated effect of general government spending and. However, the local government spending significantly crowds out private consumption. Thus, based on VAR estimations, general and central government can use government spending as private consumption stimulation tool.

The positive response of private consumption may account for sharp increase in hours worked starting from second quarter after shock combined with estimated rise in wage starting from second quarter. Thus, substitution effect offsets negative wealth effect after second quarter. These results are consistent with Keynesian and neoclassical theoretical frameworks.

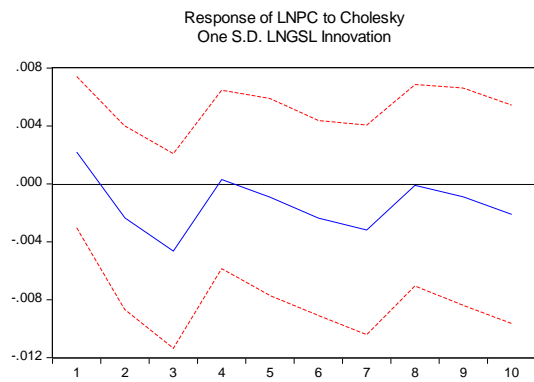


*Figure 2 VAR Impulse Response Graphs: General Government*

Interestingly, the estimated response of GDP is inconsistent with theory and negative up to fourth quarter and shows relatively small positive effect after. This may be caused by significant decrease in private investment combined with short-term decrease in private consumption.



*Figure 3 VAR Impulse Response Graphs: Central Government*



*Figure 4 VAR Impulse Response Graphs: Local Government*

## 4 Model and Application

### 4.1 Modified RBC model by Bouakez and Rebei

This section briefly introduces the modified standard RBC model presented by Bouakez and Rebei (2005). Distinct features of the model include utility specification allowing government spending influence directly utility, and households' habit formation.

The model assumes an economy, which is inhabited by infinitely lived Ricardian representative households, whose utility depends on leisure and effective consumption. Bouakez and Rebei (2005) describe effective consumption as constant elasticity of substitution index of private consumption and government spending, having the following structure:

$$Z_t = [\phi C_t^{(v-1)/v} + (1 - \phi)G_t^{(v-1)/v}]^{v/(v-1)},$$

where:

- $(Z)$  = Effective consumption
- $(C)$  = Private consumption
- $(G)$  = Government spending
- $(\phi)$  = Portion of private consumption in the effective consumption

index

- $(v)$  = Elasticity of substitution among private consumption and government spending

In case when  $v \rightarrow \infty$ , government spending and private consumption are perfect substitutes and as  $v=0$ , they become perfect compliments. Since  $\phi \in [0,1]$ , government spending becomes insubstantial in building effective consumption as  $\phi=1$ , preferences of households depend on current level of consumption only and utility function takes its standard form.

Under the habit formation, the household's preferences depend on current level of effective consumption and leisure,  $(1 - N_t)$ , and instant utility function takes the following form:

$$u(Z_t, Z_{t-1}, N_t) = \frac{1}{1 - \epsilon} (Z_t / Z_{t-1}^\gamma)^{1 - \epsilon} + \psi \ln(1 - N_t),$$

where:

- $(N_t)$  = Number of hours worked in period t
- $(\gamma)$  = Habit formation degree
- $(\epsilon > 0)$  and  $(\psi > 0)$  = Numerical parameters

Households acquire disposable income by renting labor and capital to firms and allocate it between consumption and investment decisions. By investing part of disposable income, households increase capital stock, which diminish in value over time, by:

$$K_{t+1} = (1 - \delta)K_t + I_t,$$

where:

- $(K_t)$  = Capital stock at period t
- $(I_t)$  = Investment at period t
- $(\delta)$  = Capital depreciation rate,  $\delta \in (0,1)$

Investment increases future income through growth in capital stock, but at period t it requires adjustment costs of the form:

$$\varphi(I_t, K_t) = \frac{\kappa}{2} \left( \frac{I_t}{K_t} - \delta \right)^2 K_t,$$

where  $\kappa > 0$  is numerical parameter. Also household pays lump-sum tax to government, which covers government spending entirely. Thus,  $G_t = T_t$ .

Summing up total saving-spending decisions, household's budget constraint in period t is

$$C_t + I_t + \varphi(I_t, K_t) \leq w_t N_t + r_t K_t - T_t,$$

where:

$(w_t)$  = Real wage

$(r_t)$  = Real capital rental rate

$(T_t)$  = Lump-sum tax



Household's decision problem is to maximize their life-time utility:

$$\mathbb{U}_t = E_t \sum_{s=t}^{\infty} \beta^{s-t} u(Z_s, Z_{s-t}, N_s),$$

subject to effective consumption, capital stock accumulation, investment adjustment cost and budget constraint. Marginal utility of consumption, first order condition associated with optimal choice of  $C_t$  derived as the following form:

$$\lambda_t = \phi(Z_t/C_t)^{1/\nu} \{ (1/Z_{t-1}^\gamma)(Z_t/Z_{t-1}^\gamma)^{-\epsilon} - \beta\gamma E_t[(Z_{t+1}/Z_t^{1+\gamma})(Z_{t+1}/Z_t^\gamma)^{-\epsilon}] \}.$$

where  $\lambda_t$  is Lagrange multiplier associated with budget constraint, Marginal value of capital takes value of:

$$\lambda_t = \frac{\beta E_t \{ \lambda_{t+1} [1 + r_{t+1} - \delta + \kappa(I_{t+1}/K_{t+1} - \delta) + (\kappa/2)(I_{t+1}/K_{t+1} - \delta)^2] \}}{1 + \kappa(I_t/K_t - \delta)}.$$

Marginal rate of substitution between leisure and consumption, equated to real wage derived as first order condition associated with optimal choice of  $N_t$ ,

$$\lambda_t = \psi/[w_t(1 - N_t)].$$

The representative firm for the means of production of goods for consumption employs labor and capital from households. Production technology takes standard Cobb-Douglas form:

$$Y_t = A_t K_t^\alpha N_t^{1-\alpha},$$

where  $A_t$  is technology shock. The firm chooses the amount of labor and capital to maximize the profit and the optimum is characterized by standard conditions and generate input-demand equations of following form that shows each part gets its marginal product:

$$w_t = \frac{\partial Y_t}{\partial N_t} = (1 - \alpha)Y_t/N_t,$$

$$r_t = \frac{\partial Y_t}{\partial K_t} = \alpha Y_t/K_t.$$

In order to obtain market clearing conditions, one should substitute input-demand equations and government funding condition,  $G_t = T_t$ , into the budget constraint equation that will yield the following resource constraint:

$$Y_t = C_t + I_t + G_t + \varphi(I_t, K_t).$$

he economy in this model reaches an equilibrium, which consists of the effective consumption, private consumption, government spending, output, investment, stock of capital, real wage rate, capital rate, and Lagrange multiplier that satisfy the stated above conditions. More information on the model and its implications can be found in the paper of Bouakez and Rebei from 2005 “Why does private consumption rise after government spending shock?”

To test the effect of government spending shock on private consumption, using data for Norway, the paper extends the model of Bouakez and Rebei (2005) by dividing the government expenditures into spending of general government, central government and local government. This procedure will allow seeing if expansionary fiscal policy in terms of increased government spending will stimulate private consumption on country level or local level.

## 4.2 Estimation method: ARDL Model

Autoregressive Distributed Lag Model have been used for decades, but it gained wide acceptance relatively recently. Pesaran and Shin (1998), Pesaran (2001) popularized ARDL by showing its usefulness as very valuable tool for testing long-run relationship between economics variables. According to Pesaran and Shin (1998) and Pesaran (2001), there are several advantages of ARDL model. First of all, it is suitable regardless of integration order, whether of  $I(0)$  and  $I(1)$ , however we have to be sure that none of our variables are in  $I(2)$ . Second, ARDL employs a very simple set-up of single equation that makes the process of implementation and interpretation very straightforward and smooth. Third, variables can contain different lag-length that is not necessarily equal. In addition, considering small sample estimations, ARDL gives more robust results.

The standard ARDL model take following form:

$$Y_t = \alpha_0 + \sum_{j=0}^n \beta_j \mathbb{L}^j X_t + \sum_{i=1}^m \vartheta_i \mathbb{L}^i Y_t + \varepsilon_t.$$

The model is called “autoregressive” since the dependent variable,  $Y_t$ , is partially explained by lagged value of itself,  $\mathbb{L}Y_{t-1}$ . Other than that, it also contains a distributed lag as the explanatory variable's subsequent lag,  $\mathbb{L}X_t$ .  $\varepsilon_t$  is a random disturbance term. We will assume it to behave in a usual sense, meaning it to be serially independent.

Rearranging RHS and LHS, we will receive:

$$\left(1 - \sum_{i=1}^m \vartheta_i \mathbb{L}^i\right) Y_t = \alpha_0 + \sum_{j=0}^n \beta_j \mathbb{L}^j X_t + \varepsilon_t.$$

In order to simplify the equation, we have to solve parts of equation on brackets separately. The simplification is show in details in Appendix1. After simplification, the model looks like this:

$$Y_t = \alpha_0^* + B_0^* X_t + B_j^* \Delta X_{t-j+1} + \Phi_j^* \Delta Y_{t-j+1} + \varepsilon_t^*.$$

Moreover, the equation can be rewritten in the more friendly way:

$$Y_t = \alpha_0 + \sum_{i=1}^n \vartheta_i Y_{t-1} + \sum_{j=0}^m \beta_j X_{t-j} + \varepsilon_y,$$

where:

$$C(L)Y_t = \alpha + B(\mathbb{L})X_t + \varepsilon_t,$$

$$C(L) = 1 - \vartheta_1 \mathbb{L} - \vartheta_2 L^2 - \dots - \vartheta_n \mathbb{L}^n,$$

$$B(L) = \beta_0 + \beta_1 \mathbb{L} + \beta_2 \mathbb{L}^2 + \dots + \beta_m \mathbb{L}^m.$$

## 4.3 Estimation Analysis and Results: ARDL Model

### 4.3.1 General Government Level

To test the effect of general government spending on private consumption, the following regression model was estimated:

$$LNPC = \mathcal{F}(LNGS, LNGDP, LNHW, LNI, LNW).$$

Before proceeding to model estimation, we have to be sure that none of our variables are in  $I(2)$ , so it is necessary to check the series for unit-root. In this purpose, Augmented Dickey Filter (ADF) and Dicky-Fuller Generalized Least Square (DF-GLS) tests carried out. ADF test results showed consistent results of unit-root presence in variables in both cases: when with and without trend, (t), which means that variables are integrated in  $I(1)$ . However, DF-GLS test rejected “ $H_0$ : LNGDP, LNHW, LNI have a unit-root” in presence of trend as exogenous variable. Nevertheless, in case without trend the DF-GLS test confirmed that variables have unit-root. Considering the results of both test, trend will not be included in the ARDL model specification to estimate the effects of government spending.

*Table 2 Stationarity Tests on First Difference*

VARIABLES	ADF		DF-GLS	
	c, 0	c, t	c, 0	c, t
<b>LNPC</b>	-1.8 (0.3)	-1.2 (0.9)	0.43 (0.6)	-0.5 (0.6)
<b>LNGS</b>	-1.3 (0.6)	-2.3 (0.4)	0.203 (0.8)	-2.86 (0.1)
<b>LNGDP</b>	-1.2 (0.6)	-2.9 (0.1)	0.6 (0.5)	-2.89 (0.005)
<b>LNHW</b>	-2.03 (0.2)	-3.5 (0.04)	-0.78 (0.4)	-3.46 (0.0009)
<b>LNI</b>	-3.03 (0.8)	-3.03 (0.1)	0.89 (0.3)	-2.91 (0.0048)
<b>LNW</b>	-0.88 (0.7)	-4.06 (0.01)	0.52 (0.6)	-2.32 (0.02)

Since the variables are stationary, unrestricted” error correction (ECM) is formulated as particular type of ARDL model:

$$\begin{aligned}\Delta PC_t = & \beta_0 + \sum_{i=1}^m \beta_i \Delta PC_{t-1} + \sum_{j=0}^n \gamma_j \Delta GS_{t-j} + \sum_{k=0}^n \delta_k \Delta GDP_{t-k} + \sum_{r=0}^n \sigma_r \Delta I_{t-r} \\ & + \sum_{p=0}^n \nu_p \Delta HW_{t-p} + \sum_{q=0}^n \iota_q \Delta WG_{t-q} + \theta_0 PC_{t-1} + \theta_1 GS_{t-1} + \theta_2 GDP_{t-1} \\ & + \theta_3 I_{t-1} + \theta_4 HW_{t-1} + \theta_5 WG_{t-1} + \varepsilon_t.\end{aligned}$$

Where  $PC_{t-1}$ ,  $GS_{t-1}$ ,  $GDP_{t-1}$ ,  $I_{t-1}$ ,  $HW_{t-1}$ ,  $WG_{t-1}$  are used as error correction terms. Thenext step in our analysis is to set the appropriate numbers of lags. Akaike (AIC) and Schwarz (SC) criterions are used to select number of lags among 2, 4, and 6. Table 3 shows the estimated results for different number of lags. Since the smallest number of AIC and SC is belongs to 2 lags parameter, the maximum number of lags is considered to be 2.

*Table 3 Selected Maximum Lag Base: General Government*

# OF LAGS	AIC	SC
2	-4.71	-4.137
4	-5.5841	-4.6262
6	-5.6951	-4.346

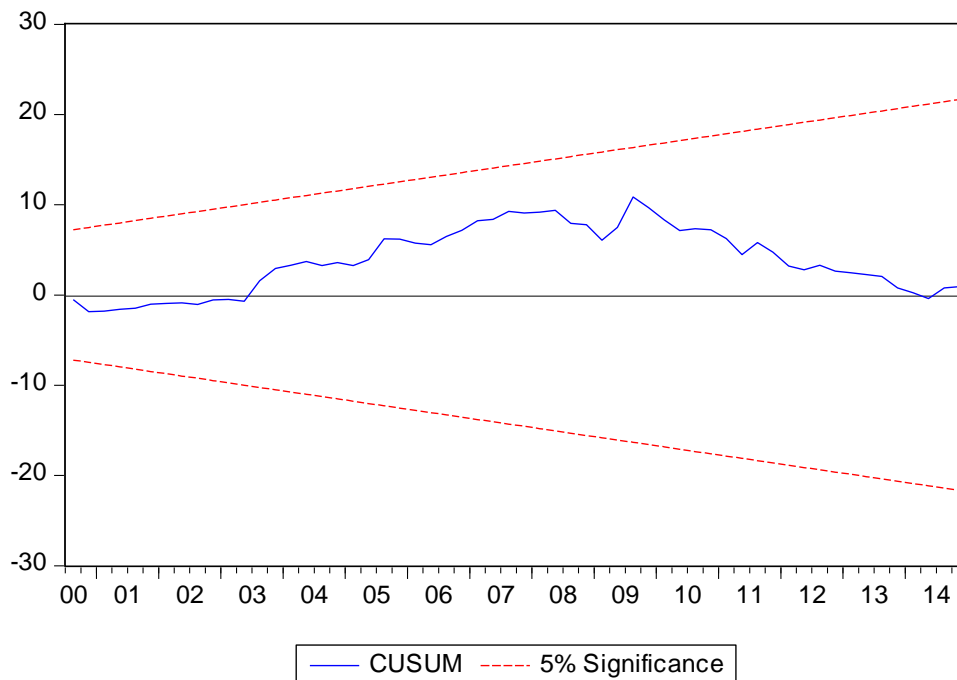
Next, we have to check for no correlation among the residuals. If we find so, the equation have to be reconsidered and rearranged. To check it the Breusch-Godfrey Serial Correlation LM Test is applied with null hypothesis of no serial correlation in the residuals up to the specified order,. The results of LM test report that there is no evidence that null hypothesis can be rejected, but rather accept it. In other words, there is no serial correlation in the residuals up to second order and the set up estimation regression can be used for hypothesis testing and forecasting the response of private consumption on government spending shocks.

*Table 4 Serial Correlation Test: General Government*

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.793467	Prob. F(2,56)	0.4573
Obs*R-squared	2.121904	Prob. Chi-Square(2)	0.3461

Before proceeding to ARDL Bound Cointegration Test, we have to verify the model's stability, which is checked by Cusum test. The results confirm stability of the model under 5% significance level.



*Figure 5 Dynamic Stability Test: General Government*

At this point, we have verified that none of our variables are involved in I(2), selected best fitted lag number, checked for absence of serial correlation, and proved that our model is stable. Now, we can proceed to ARDL Bound Cointegration test to check if there is long-run cointegration relationship among private consumption, government spending, GDP, hours worked, wage, and investment. Wald test is used to estimate long-run cointegration and to check the null hypothesis:

$$H_0: \text{LNPC}(-1) = \text{LN GS}(-1) = \text{LN GDP}(-1) = \text{LN WG}(-1) = \text{LN HW}(-1) = \text{LN I}(-1) = 0$$

According to Pesaran et al. (2001), to test the existence of a long-run relationship for our model, critical value bounds of F-statistic have to be compared with Wald test F-statistic. Under 95%, for five regressors the lower bound is 2.649 and the upper bound is 3.805. As stated by Pesaran et al. (2001), if F-statistic is smaller than lower bound, then there is no long-run cointegration relationship among the tested variables. If F-statistic is greater than upper bound, then there is cointegration and long-term relationship among estimated variables. If F-statistic falls in between of lower and upper bounds, then the results are inconclusive and different method is required.

Table 5 presents the estimated results of Wald test. The estimated F-statistic is  $4.13 > 3.805$ , which shows moderately strong evidence that null hypothesis does not hold. It means there is long-run cointegration relationship between variables and we can estimate coefficients of private consumption, government spending, GDP, hours worked, wage, and investment using Error Correction Model (ECM).

*Table 5 Presence of Long Run Relationship Test: General Government*

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	4.138034	(6, 58)	0.0325
Chi-square	12.82820	6	0.0458

The final step is to run ECM:

$$\begin{aligned}
\Delta PC_t = & \beta_0 + \sum_{i=1}^m \beta_i \Delta PC_{t-i} + \sum_{j=0}^n \gamma_j \Delta GS_{t-j} + \sum_{k=0}^n \delta_k \Delta GDP_{t-k} + \sum_{r=0}^n \sigma_r \Delta I_{t-r} \\
& + \sum_{p=0}^n \nu_p \Delta HW_{t-p} + \sum_{q=0}^n \iota_q \Delta WG_{t-q} + \theta_0 PC_{t-1} + \theta_1 GS_{t-1} + \theta_2 GDP_{t-1} \\
& + \theta_3 I_{t-1} + \theta_4 HW_{t-1} + \theta_5 WG_{t-1} + \varepsilon_t.
\end{aligned}$$

The results of short-run response of private consumption on regression variables is shown in Table 6. Estimated results show negative wealth effect for short period after shock. Moreover, they are consistent VAR outcome, when private consumption decreased in first quarter, but



after experienced trend of growth. In the short-run, the expansion of general government spending will reduce private consumption by 0.06 percent. The effect of GDP on consumption is as predicted by both neoclassical and New-Keynesian theories, on average 1 percent change in GDP will lead to 0.3 percent increase in private consumption. The same positive and consistent with theories effect comes from wage and working hours factors. As it comes to investment, then the results negative but statistically insignificant. The regression model successively explained 85 percent of private consumption variation. The coefficient of ECT, which is equal to 10.9 percent, shows with what speed the system can get to long run equilibrium.

*Table 6 Short Run Coefficients: General Government*

Dependent Variable: D(LNPC)

Method: Least Squares

Date: 10/13/15 Time: 19:00

Sample (adjusted): 1995Q4 2014Q4

Included observations: 77 after adjustments

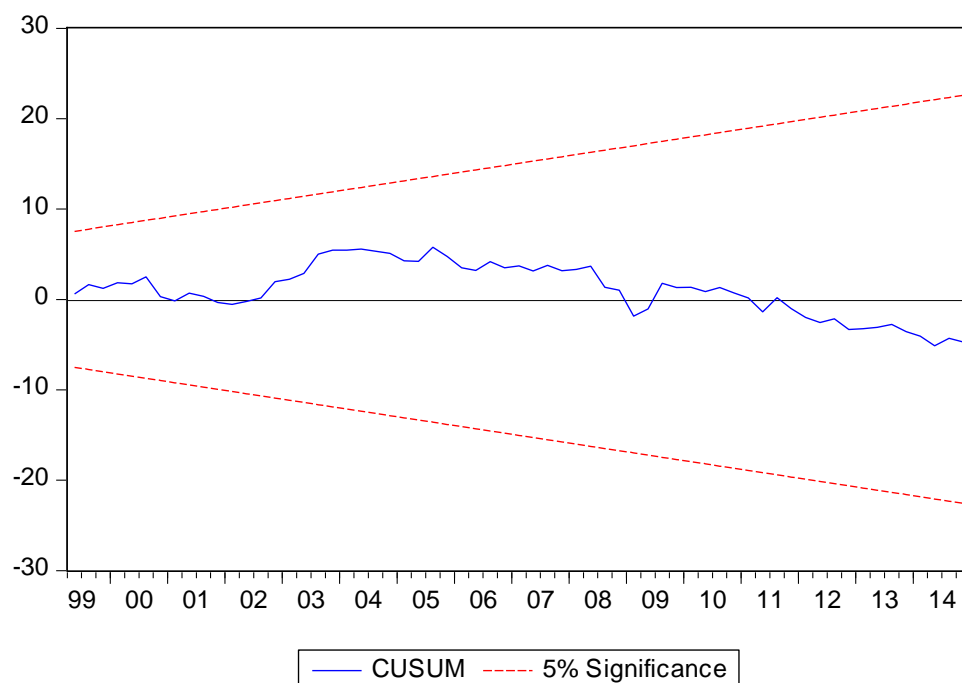
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.024822	0.007248	3.424705	0.0011
D(LNPC(-1))	-0.208951	0.161665	-1.292497	0.2009
D(LNPC(-2))	-0.303337	0.114118	-2.658101	0.0099
D(LNGS(-1))	-0.452770	0.131501	-3.443082	0.0010
D(LNGS(-2))	-0.061858	0.141900	-0.435930	0.0044
D(LNY(-1))	0.385660	0.097036	3.974409	0.0002
D(LNY(-2))	0.312245	0.106985	2.918577	0.0049
D(LNW(-1))	0.513254	0.267162	1.921137	0.0592
D(LNW(-2))	0.096876	0.244427	0.396341	0.6932
D(LNH(-1))	0.796086	0.150237	5.298868	0.0000
D(LNH(-2))	0.230123	0.158040	1.456110	0.1503
D(LNI(-1))	-0.022694	0.055166	-0.411378	0.6822
D(LNI(-2))	-0.088038	0.056585	-1.555842	0.1248
ECT(-1)	-0.109422	0.169581	-0.645252	0.5211
R-squared	0.882966	Mean dependent var	0.013453	
Adjusted R-squared	0.858817	S.D. dependent var	0.057985	
S.E. of regression	0.021787	Akaike info criterion	-4.652001	
Sum squared resid	0.029906	Schwarz criterion	-4.225855	
Log likelihood	193.1020	Hannan-Quinn criter.	-4.481546	
F-statistic	36.56208	Durbin-Watson stat	2.264452	
Prob(F-statistic)	0.000000			

To finish with short-run analysis, we have to make sure that the absence of serial correlation and stability for the short turn. Breusch-Godfrey Serial Correlation LM and Cusum tests are used as previously. The results are presented in Table 7, Figure 6 and verify the absence of serial correlation and stability of the ARDL model for short run.

*Table 7 Short-run ECT Correlation Test: General Government*

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	5.082800	Prob. F(2,61)	0.091
Obs*R-squared	10.99901	Prob. Chi-Square(2)	0.041



*Figure 6 Dynamic Stability Test ECT Test: General Government*

The long-run response of private consumption is fully consistent with both neoclassical and New-Keynesian theories. As was predicted by model developed by Bouakez and Rebei (2005), positive general government spending shock will increase private consumption by 0.26 percent. Thus short-term substitution effect, which works through increase in working hours, offsets negative wealth effect. The biggest effect on private consumption occurs to change in wage variable, which is logically correct since wage increases disposable income of households. Negative effect of investment is not consistent with estimated model of Bouakez and Rebei (2005), where investment tend to increase consumption through capital accumulation.

*Table 8 Long Run Coefficients: General Government*

Dependent Variable: LNPC

Method: Least Squares

Date: 10/13/15 Time: 20:19

Sample (adjusted): 1995Q2 2014Q4

Included observations: 79 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.427443	0.777505	-0.549762	0.0052
LNGS(-1)	0.262370	0.139507	1.880690	0.0240
LNYS(-1)	0.129132	0.081058	1.593090	0.0155
LNW(-1)	1.273992	0.173226	7.354498	0.0000
LNH(-1)	0.344413	0.180149	1.911828	0.0498
LNI(-1)	-0.228269	0.058521	-3.900621	0.0002
R-squared	0.985357	Mean dependent var	12.17217	
Adjusted R-squared	0.984354	S.D. dependent var	0.306802	
S.E. of regression	0.038376	Akaike info criterion	-3.609835	
Sum squared resid	0.107511	Schwarz criterion	-3.429877	
Log likelihood	148.5885	Hannan-Quinn criter.	-3.537738	
F-statistic	982.4343	Durbin-Watson stat	1.249945	
Prob(F-statistic)	0.000000			

### 4.3.2 Central and Local Government Level

The analysis of response of private consumption to an increase in government spending on general level, which includes both central and local governments, showed slightly negative response in short-run period and sufficiently positive response in the long run that is consistent with theory. Expansion of general government spending, which is entirely financed by lump-sum taxes, decreases disposable income of households that causes negative wealth effect. Thus, households cut private consumption to smooth it over lifetime. However, the substitution effect, which makes households work more, thus, increase disposable income, rises consumption of households. The empirical estimation of this paper showed that substitution effect is greater than negative effect in the long-run, thus private consumption positively responses to general government spending shock.

This part of the empirical analysis will estimate if the positive tendency is maintained on the central and local government levels. As in the previous analysis of the private consumption's response to changes in general government spending, the starting point of estimation is to check if the central government spending and local government spending variables are not involved in I(2). The same procedures of ADF and DF-GLS tests are applied. The results of the tests proved that central and local government spending are stationary or have a unit root in both cases with and without trend factor. The results are presented in the following Table 9.

*Table 9 Stationarity Test on First Difference: Central and Local Government Spending*

	ADF		DF-GLS	
	c,0	c, trend	c,0	c, trend
<b>LNGSC</b>	-0.92 (0.7)	-1.4 (0.82)	2.17 (0.052)	-1.59 (0.1)
<b>LNGSL</b>	-0.5 (0.9)	-1.69 (0.74)	2.18 (0.05)	-1.74 (0.08)

The particular type of ARDL model, unrestricted ECM, can now be constructed separately for each level of government. In case of central government, the estimation equation of unrestricted ECM will be following:

$$\begin{aligned}\Delta PC_t = & \beta_0 + \sum_{i=1}^m \beta_i \Delta PC_{t-i} + \sum_{j=0}^n \gamma_j \Delta GSC_{t-j} + \sum_{k=0}^n \delta_k \Delta GDP_{t-k} + \sum_{r=0}^n \sigma_r \Delta I_{t-r} \\ & + \sum_{p=0}^n \nu_p \Delta HW_{t-p} + \sum_{q=0}^n \iota_q \Delta WG_{t-q} + \theta_0 PC_{t-1} + \theta_1 GSC_{t-1} + \theta_2 GDP_{t-1} \\ & + \theta_3 I_{t-1} + \theta_4 HW_{t-1} + \theta_5 WG_{t-1} + z_t.\end{aligned}$$

where, GSC is central government spending.

The next step is to define maximum appropriate number of lags using Akaike (AIC) and Schwarz (SC) criteria. The number of lags, suggested by both criteria, is two, which is the same as in the previous analysis of general government spending.

*Table 10 Selected Maximum Lag Base: Central Government*

# OF LAGS	AIC	SC
2	-4.609	-4.031
4	-5.623	-4.665
6	-5.406	-4.057

Now, the presence of serial correlation has to be tested by Breusch-Godfrey serial correlation LM test. The estimated probability shows that there is no evidence to reject null hypothesis rather to accept it. In other words, there is no serial correlation among the variables of particular model. The results of LM test can be found in Table 11.

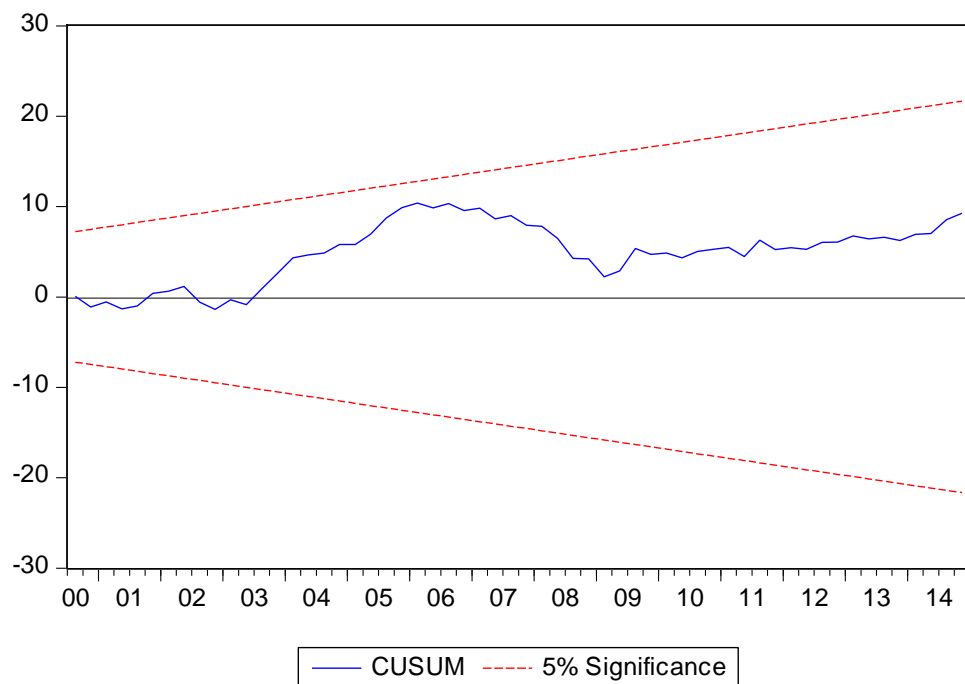
*Table 11 Serial Correlation Test: Central Government*

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	4.477250	Prob. F(2,56)	0.0157
Obs*R-squared	10.61507	Prob. Chi-Square(2)	0.0050

To check if the model is dynamically stable, Cusum test is carried out. The test shows the stability of the ECM model under 5% significance. The results are presented in the following Figure4. Since, the central government spending variable is stationary, the most appropriate

number of lags have been selected, the model does not include serial correlation and dynamically stable, we can proceed to Wald test to see if there is long-run correlation among private consumption, central government spending, GDP, hours worked, wage, and investment and if they jointly affect private consumption.



*Figure 7 Dynamic Stability: Central Government*

To check the long-run causation, the Pesaran et al. (2001) parameters of lower bound and upper bound, which are the same as in the previous analysis, are used. The results of test can be found in Table 11. The Wald test estimated F-statistic equal to 3.92, which is greater than Pesaran upper bound for five regressors under 95% significance level, 3.805. This means that private consumption, government spending, GDP, hours worked, wage, and investment have long-run relationship and further estimation of coefficients can be held.

*Table 72 Presence of Lon-Run Relationship: Central Government*

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	3.924542	(6, 58)	0.0101
Chi-square	18.74725	6	0.0046

The core of analysis is to check the short-run and long-run coefficients for private consumption response. The estimated results for short-run are presented in Table12, for long-run in Table13. The short-run effect of expansion in central government spending on private consumption is positive but small and statistically significant under 10% significance level. The long-run results estimated strong and positive statistically significant coefficient of 0.16. The rest of the variables follow the logic of the model. Wage and hours factors increase disposable income of households, which will rise private consumption. Increase in output will stimulate economy, thus increasing the level of consumption. As for the investment, it will generate increase in private consumption through capital accumulation.

The analysis of effects of local government spending shocks, based on the ECM of particular type:

$$\begin{aligned}\Delta PC_t = & \beta_0 + \sum_{i=1}^m \beta_i \Delta PC_{t-i} + \sum_{j=0}^n \gamma_j \Delta GSL_{t-j} + \sum_{k=0}^n \delta_k \Delta GDP_{t-k} + \sum_{r=0}^n \sigma_r \Delta I_{t-r} \\ & + \sum_{p=0}^n \nu_p \Delta HW_{t-p} + \sum_{q=0}^n \iota_q \Delta WG_{t-q} + \theta_0 PC_{t-1} + \theta_1 GSL_{t-1} + \theta_2 GDP_{t-1} \\ & + \theta_3 I_{t-1} + \theta_4 HW_{t-1} + \theta_5 WG_{t-1} + z_t.\end{aligned}$$

involves the same logic. Breusch-Godfrey serial correlation LM test and Cusum stability check proved the absence of serial correlation and dynamically stability of the particular model for the local government level. Wald test generated F-statistic equal to 12.22, which is greater than 3.805 (Pesaran et al., 2001). The Tables and Figures for analysis of local government spending are presented in Appendix 2. We proceed directly to the short-run and long-run coefficients analysis.

The short-run estimated coefficient of local government spending is negative and statistically significant for lag1. The coefficients of GDP and wage factor is estimated to be positive and statistically significant. The hours worked and investment coefficients estimated to be negative and statistically insignificant in lag1. The long-run estimates coefficient of local government spending is negative and statistically insignificant, meaning that the estimated regression failed to estimate the effect of local government spending on private consumption. The coefficients of the rest of the variable are positive and statistically significant, among which the greatest influence is generated by wage factor.

*Table 83 Short-Run Coefficients: Central Government*

Dependent Variable: D(LNPC)

Method: Least Squares

Date: 10/13/15 Time: 21:56

Sample (adjusted): 1996Q1 2014Q4

Included observations: 76 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000914	0.006253	-0.146217	0.8842
D(LNPC(-1))	0.380257	0.164215	2.315608	0.0239
D(LNPC(-2))	-0.045519	0.110874	-0.410549	0.0628
D(LNGSC(-1))	0.026137	0.069782	0.374562	0.0493
D(LNGSC(-2))	0.060961	0.067475	0.903466	0.3698
D(LNY(-1))	-0.300241	0.089334	-3.360879	0.0013
D(LNY(-2))	0.597361	0.120639	4.951620	0.0000
D(LNW(-1))	1.001388	0.238106	4.205646	0.0001
D(LNW(-2))	-0.754428	0.262800	-2.870731	0.0056
D(LNH(-1))	0.255158	0.155833	1.637386	0.1066
D(LNH(-2))	-0.989142	0.205392	-4.815882	0.0000
D(LNI(-1))	0.026676	0.051619	0.516779	0.6071
D(LNI(-2))	-0.102409	0.052037	-1.968007	0.0535
ECTC(-1)	-1.086057	0.236069	-4.600594	0.0000
R-squared	0.898006	Mean dependent var	0.012564	
Adjusted R-squared	0.876620	S.D. dependent var	0.057840	
S.E. of regression	0.020316	Akaike info criterion	-4.789952	
Sum squared resid	0.025591	Schwarz criterion	-4.360606	
Log likelihood	196.0182	Hannan-Quinn criter.	-4.618365	
F-statistic	41.99061	Durbin-Watson stat	1.842519	
Prob(F-statistic)	0.000000			



*Table 94 Long-Run Coefficients: Central Government*

Dependent Variable: LNPC  
Method: Least Squares  
Date: 10/13/15 Time: 22:47  
Sample: 1995Q1 2014Q4  
Included observations: 80

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.350106	0.706207	1.911771	0.0598
LNGSC	0.163847	0.045070	3.635368	0.0005
LNy	0.281521	0.074038	3.802377	0.0003
LNW	0.232464	0.097330	2.388407	0.0195
LNH	0.311853	0.164202	1.899200	0.0614
LNI	0.128478	0.051653	2.487350	0.0151
R-squared	0.988375	Mean dependent var	12.16443	
Adjusted R-squared	0.987589	S.D. dependent var	0.312622	
S.E. of regression	0.034827	Akaike info criterion	-3.804795	
Sum squared resid	0.089757	Schwarz criterion	-3.626143	
Log likelihood	158.1918	Hannan-Quinn criter.	-3.733169	
F-statistic	1258.290	Durbin-Watson stat	2.101216	
Prob(F-statistic)	0.000000			

### **4.3.3 Limitations**

Even if the estimated in this paper response of private consumption is consisted with Keynesian theory and modified RBC model by Bouakez and Rebei (2005), the analysis is rough and on average. The real economy operation is way more complicated and includes many more variables and implications. For example, the model estimated in this paper does not include variables as disposable income, taxes and financial market and labor market conditions that influence the behavior of household in consumption decision (Gali et al., 2007) Next limitation can be data processing, which is differs from Bouakez and Rebei (2005) analysis. As one of the limitation can be considered the assumptions employed in the paper. Household`s utility may not be effective and may not depend on government spending, rather it may depend of number of factor as lifetime income, access to financial market etc. Another limitation of the analysis provided in the paper, may be inappropriate model to study the effects of local government spending expansion. Thus, there questions are left of further studies and discussions.

## 5 Conclusion

This paper studies the response of private consumption on increase in government spending in case of Norway by applying the modified RBC model by Bouakez and Rebei (2005). In addition, the paper considers government spending on three scale levels: general, central and local government expenditures. The results of the paper proves the presence of crowding in effect in scale of general government for long-run period, having small decrease in the short-run, which is consistent with theory and model. The results of VAR estimation for general government spending completely match the estimated results of ARDL model. For central government spending, the response of private consumption is positive, small for short-run and strong for long run. While VAR estimation for central government spending predicts small decline in the first quarter, but sufficient increase after second quarter. However, the response of private consumption on increase in local government spending is estimated to be negative both for short-run and long run periods. The negative results may arise due to inappropriate method to estimate local government spending expansion. The results match with VAR estimation, where private consumption's respond is negative and persistent. The estimated negative results are consistent with neoclassical theoretical framework. Thus, fiscal policy stimulation through expansion in government spending turns to be effective and generate crowding in effect only for country level, while for lower scale it may cause drastic decrease in private consumption causing crowding out effect.

# Litteraturliste

[Følg instruksene ditt fakultet/institutt har for skriving av litteraturlister]

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# Appendix 1

$$\begin{aligned}
\sum_{j=0}^n \beta_j \mathbb{L}^j X_t &= \sum_{j=0}^n \beta_j X_t - \sum_{j=1}^n \beta_j X_t + \sum_{j=1}^n \beta_j X_{t-1} - \sum_{j=2}^n \beta_j X_{t-1} + \sum_{j=2}^n \beta_j X_{t-2} - \sum_{j=3}^n \beta_j X_{t-2} \\
&\quad + \sum_{j=3}^n \beta_j X_{t-3} - \cdots - \beta_n X_{t-n+1} \\
&= \sum_{j=0}^n \beta_j X_t - \sum_{j=1}^n \beta_j \Delta X_t - \sum_{j=2}^n \beta_j \Delta X_{t-1} - \sum_{j=3}^n \beta_j \Delta X_{t-2} - \cdots - \beta_n X_{t-n+1} \\
&= B_0 X_t - \sum_{j=0}^n B_j \Delta X_{t-1}.
\end{aligned}$$

$$\begin{aligned}
&\left(1 - \sum_{i=1}^m \vartheta_i \mathbb{L}^i\right) Y_t \\
&= Y_t - \sum_{i=1}^m \varphi_i \mathbb{L}^i Y_t = Y_t - \sum_{i=1}^m \varphi_i Y_t + \sum_{i=1}^m \varphi_i Y_t - \sum_{i=1}^m \varphi_i Y_{t-1} + \sum_{i=2}^m \varphi_i Y_{t-1} \\
&\quad - \sum_{i=2}^m \varphi_i Y_{t-2} + \sum_{i=3}^m \varphi_i Y_{t-2} - \sum_{i=3}^m \varphi_i Y_{t-3} + \cdots + \varphi_m Y_{t-m} \\
&= \left(1 - \sum_{i=1}^m \vartheta_i\right) Y_t + \sum_{i=1}^m \vartheta_i \Delta Y_t + \sum_{i=2}^m \vartheta_i \Delta Y_{t-1} + \sum_{i=3}^m \vartheta_i \Delta Y_{t-2} + \cdots \\
&\quad + \vartheta_m \Delta Y_{t-m+1} = (1 - \Phi_1) Y_t + \sum_{i=1}^m \Phi_i \Delta Y_{t-j+1}.
\end{aligned}$$

$$Y_t = \frac{\alpha_0}{1 - \Phi_1} + \frac{B_0}{1 - \Phi_1} X_t + \frac{\sum_{i=1}^n B_i}{1 - \Phi} \Delta X_{t-j+1} + \frac{\sum_{i=1}^m \Phi_i}{1 - \Phi_1} \Delta Y_{t-j+1} + \frac{\varepsilon_t}{1 - \Phi_1},$$

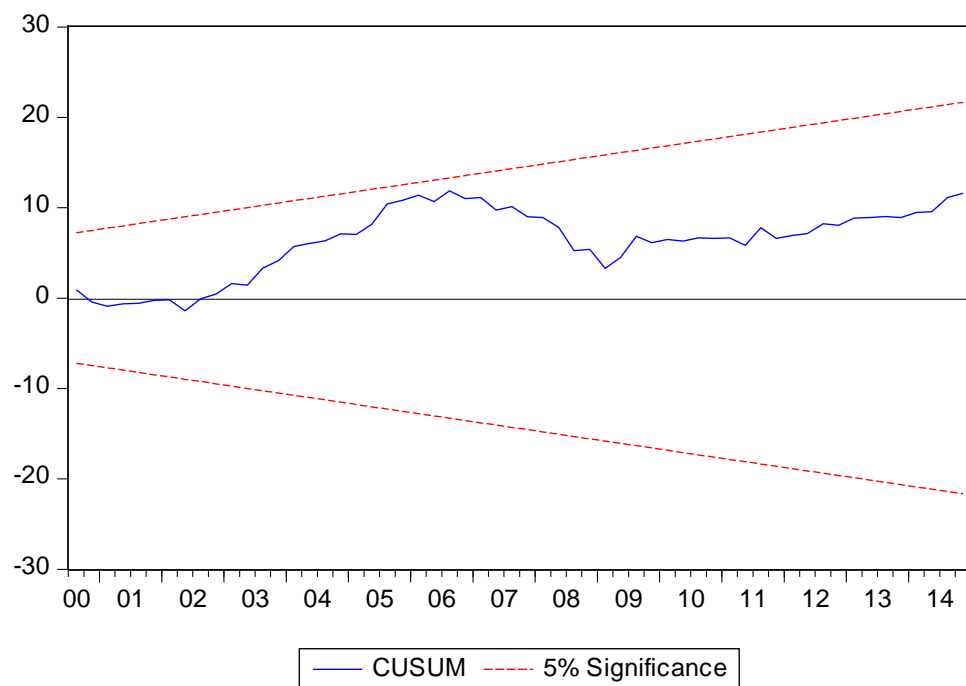
$$Y_t = \alpha_0^* + B_0^* X_t + B_j^* \Delta X_{t-j+1} + \Phi_j^* \Delta Y_{t-j+1} + \varepsilon_t^*.$$

# Appendix 2

*Table 105 Serial Correlation Test: Local Government*

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	4.884109	Prob. F(2,56)	0.0111
Obs*R-squared	11.43642	Prob. Chi-Square(2)	0.0033



*Figure 8 Dynamic Stability Test: Local Government*

*Table 116 Presence of Long Run Relationship: Local Government*

Wald Test:

Equation: Untitled

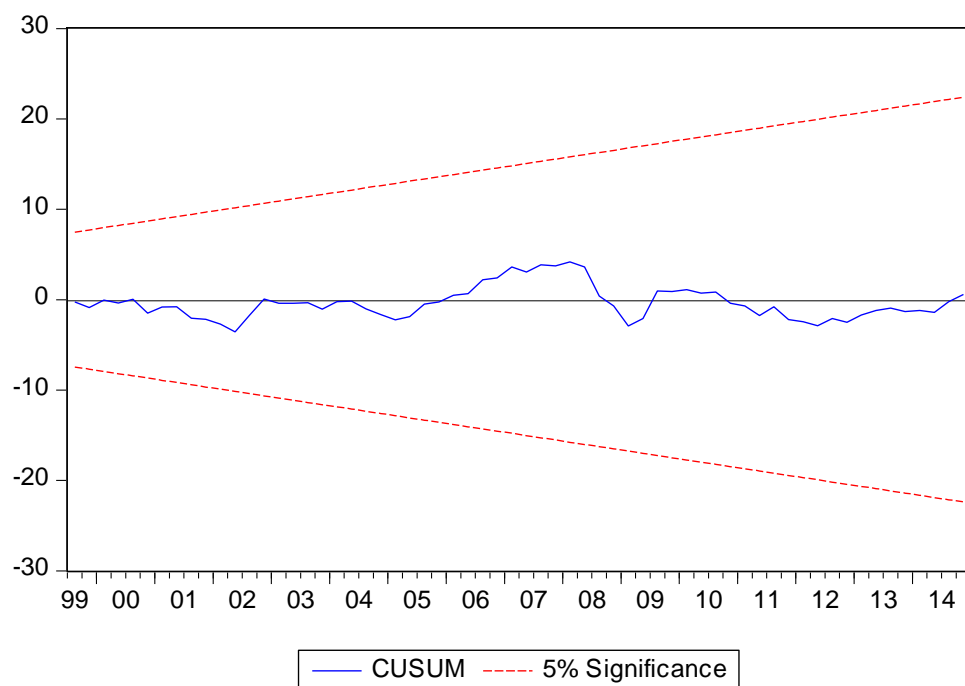
Test Statistic	Value	df	Probability
F-statistic	12.22126	(6, 58)	0.0536
Chi-square	13.32760	6	0.0381



*Table 127 Short Run ECTL Correlation Test: Local Government*

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.265788	Prob. F(2,60)	0.2894
Obs*R-squared	3.076843	Prob. Chi-Square(2)	0.2147



*Figure 9 Dynamic Stability Test ECTL: Local Government*

*Table 138 Short Run Coefficient: Local Government*

Dependent Variable: D(LNPC)  
Method: Least Squares

Date: 10/13/15 Time: 22:38  
Sample (adjusted): 1996Q1 2014Q4  
Included observations: 76 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004955	0.005780	0.857211	0.3946
D(LNPC(-1))	0.282135	0.157921	1.786555	0.0789
D(LNPC(-2))	-0.145874	0.113097	-1.289811	0.2019
D(LNGSL(-1))	-0.073895	0.063401	-1.165523	0.0483
D(LNGSL(-2))	0.113483	0.064921	1.748001	0.0854
D(LNY(-1))	-0.288282	0.091389	-3.154442	0.0025
D(LNY(-2))	0.545442	0.116687	4.674389	0.0000
D(LNW(-1))	0.882634	0.232849	3.790581	0.0003
D(LNW(-2))	-0.717677	0.257401	-2.788164	0.0070
D(LNH(-1))	0.372282	0.157126	2.369318	0.0209
D(LNH(-2))	-0.870568	0.200244	-4.347535	0.0001
D(LNI(-1))	0.019743	0.051072	0.386565	0.7004
D(LNI(-2))	-0.099196	0.051829	-1.913899	0.0603
ECTL(-1)	-0.911131	0.215947	-4.219245	0.0001
R-squared	0.899063	Mean dependent var	0.012564	
Adjusted R-squared	0.877898	S.D. dependent var	0.057840	
S.E. of regression	0.020211	Akaike info criterion	-4.800367	
Sum squared resid	0.025326	Schwarz criterion	-4.371022	
Log likelihood	196.4140	Hannan-Quinn criter.	-4.628780	
F-statistic	42.48017	Durbin-Watson stat	1.819149	
Prob(F-statistic)	0.000000			

*Table 19 Long Run Coefficients: Local Government*

Dependent Variable: LNPC  
Method: Least Squares  
Date: 10/13/15 Time: 22:42  
Sample: 1995Q1 2014Q4  
Included observations: 80

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.531879	0.718559	0.740202	0.4615
LNGSL	-0.085235	0.064788	-1.315603	0.1924
LNY	0.360382	0.076024	4.740368	0.0000
LNW	0.530387	0.113664	4.666274	0.0000
LNH	0.270621	0.175829	1.539118	0.1280
LNI	0.043979	0.048813	0.900958	0.3705
R-squared	0.986612	Mean dependent var	12.16443	
Adjusted R-squared	0.985707	S.D. dependent var	0.312622	

S.E. of regression	0.037375	Akaike info criterion	-3.663594
Sum squared resid	0.103370	Schwarz criterion	-3.484942
Log likelihood	152.5438	Hannan-Quinn criter.	-3.591967
F-statistic	1090.642	Durbin-Watson stat	1.942502
Prob(F-statistic)	0.000000		

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